CLAIMS

What is claimed is:

1. A logging tool for measuring electrical resistivity of geologic formations through an electrically conductive and magnetically permeable well or bore hole casing comprising:

(a) a saturating means for (i) generating a magnetic flux, and (ii) engaging the magnetic flux with a portion of the casing without physical contact between the saturating means and the casing, for (iii) creating at least one magnetically saturated portion of the casing extending through the thickness of the casing ;

(b) a transmitter means for generating and transmitting an oscillating magnetic flux through the saturated portion of the casing; and

(c) a receiver means for detecting the oscillating magnetic flux transmitted from the exterior of the saturated portion of the casing.

2. The apparatus defined in claim 1 wherein the transmitter means and the receiver means are proximate to the saturated portion of the casing.

3. The apparatus defined in claim 1 further comprising means for moving the apparatus through the axial direction of the casing.

4. The apparatus defined in claim 3 further comprising at least one housing to contain the saturating means, the transmitter means and the receiver means.

5. The apparatus defined in claim 4 wherein the housing comprises at least one of a non-magnetically permeable material and a non-electrically conductive material.

6. The apparatus defined in claim 4 wherein the housing comprises non-magnetically permeable material.

7. The apparatus of claim 6 wherein the housing comprises stainless steel.

8. The apparatus defined in claim 4 wherein the housing comprises non electrically conductive material.

9. The apparatus defined in claim 1 further comprising at least one separately located power source.

10. The apparatus defined in claim 1 further comprising at least one means separately located from the saturation means, transmitter means and receiver means for receiving an electrical signal corresponding to the oscillating magnetic flux detected by the receiver means and connected to the receiver by means to transmit such electrical signal.

11. The apparatus defined in claim 10 further comprising means to display the received electrical signal and the location of the receiver in the axial length of the casing.

12. The apparatus defined in claim 10 further comprising means to record the received electrical signal and the location of the receiver.

13. The apparatus defined in claim 11 further comprising means to record the received electrical signal and the location of the receiver.

14. The apparatus defined in claim 1 further comprising electrical power storage means to provide electricity for generating, transmitting and receiving magnetic flux.

15. The apparatus defined in claim 14wherein the electrical power storage means is at least one battery.

16. The apparatus defined in claim 15 further comprising means to record the electrical signal received and the location of the housing within the axial length of the casing.

17. The apparatus defined in claim 16 further comprising means to move the housing within the casing without mechanical attachment to a separately located control.

18. The apparatus defined in claim 1 wherein at least one of the transmitters is located proximate to the saturation means and at least one receiver means is located proximate to another saturation means.

~~19~~ 18. The apparatus defined in claim 1 further comprising transmitting a plurality of differing frequencies of oscillating magnetic flux.

~~20~~ 19. The apparatus defined in claim ~~19~~ 18 wherein the differing frequencies of oscillating magnetic flux are transmitted simultaneously.

~~21~~ 20. The apparatus defined in claim ~~19~~ 18 wherein the differing frequencies of oscillating magnetic flux are transmitted sequentially.

22. The apparatus defined in claim 1 wherein a plurality of saturation means, transmitter means and receiver means are horizontally oriented in different directions.

23. The apparatus defined in claim 1 wherein (i) the saturation means engages the interior side of the casing with magnetic flux but does not saturate the casing through to the exterior side, (ii) the oscillating magnetic flux generated and transmitted by the transmitter means induces eddy currents within the partially saturated portion of the casing, (iii) receiver means detects oscillating magnetic flux generated within electrically conductive media located exterior to the casing by eddy currents induced within the media by the oscillating magnetic flux emitted from the partially saturated casing.

24. The apparatus defined in claim 23 further comprising means to modify the partially saturated area of the casing in a controllable manner in order that the oscillating magnetic flux emitted from the exterior side of the partially saturated casing is directed in an intended manner.

25. The apparatus defined in claim 23 further comprising means to change the shape of the partially saturated area.

26. The apparatus defined in claim 23 further comprising means to modify the permeability of the partially saturated casing.

27. The apparatus defined in claim 23 further comprising means to modify the partially saturated casing in relation to the saturation of the casing proximate to one or more receivers.

28. The apparatus defined in claim 23 further comprising a lens device between the transmitter means and the casing to modify the direction of the oscillating flux emitted from the exterior of the casing.

29. The apparatus defined in claim 28 further comprising the lens device contained within the housing.

30. The apparatus defined in claim 23 wherein the means to control the saturation means reduces the electric power utilized by the saturation means.

30 31. The apparatus defined in claim 1 wherein the magnetic flux generated by the saturating means is at a constant amplitude.

32. The apparatus defined in claim 1 wherein the saturation means and the transmitter means utilize the same electrically conductive coil.

33. The apparatus defined in claim 1 wherein the saturation means utilizes a dc electrical power and the transmitter means uses ac electrical power.

34. The apparatus defined in claim 1 wherein the saturation means comprises a permanent magnet.

34 35. The apparatus defined in claim 1 further comprising means to measure the conductivity of the casing proximate to the logging tool.

35 36. The apparatus defined in claim 1 further comprising means to measure the permeability of the casing proximate to the apparatus.

36 37. The apparatus defined in claim 34 35 further comprising means to measure the thickness of the casing proximate to the logging tool.

37 38. The apparatus defined in claim 1 further comprising a means to null the transmission of signals directly from the transmitter means to the receiver means.

38 39. The apparatus defined in claim 37 38 wherein the nulling means comprises geometric nulling.

40. The apparatus defined in claim 39 wherein the receiver is configured on a plane normal to the plane of the transmitter.

41. The apparatus defined in claim 33 wherein the transmitter means and receiver means are separated by magnetically unsaturated material.

42. The apparatus defined in claim 38 wherein the transmitter means is placed upon a material having sufficient mass and magnetic permeability to direct the transmitter flux in a manner to minimize the quantity of transmitter flux reaching the receiver means.

43. A method for detecting electrically resistive media within a geologic formation by transmitting and receiving magnetic flux through an electrically conductive and magnetically permeable casing comprising the steps of:

(a) creating at least one magnetic flux within the interior of the casing using a flux generating means;

(b) engaging the interior side of the casing with the magnetic flux without physical contact between the flux generating means and the casing for creating at least one magnetically saturated area which extends through a thickness of the casing to the exterior side;

(c) creating at least one oscillating magnetic flux;

(d) transmitting oscillating magnetic flux through at least one magnetically saturated area of the casing to induce eddy currents within electrically conductive media located proximate to the exterior side of the magnetically saturated casing; and

(e) using at least one receiver means located inside the casing for detecting oscillating magnetic flux transmitted through the casing that is induced by the eddy currents within the electrically conductive media proximate to the exterior side of the magnetically saturated casing.